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REVIEW ARTICLE

Prospects and Challenges of Population Health with Online and other Big Data in Africa; Understanding the Link to Improving Healthcare Service Delivery

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ABSTRACT

Big data analytics offers promises to many health care service challenges and can provide answers to many population health issues. Big data is having a positive impact in almost every sphere of life in more advanced world while developing countries are striving to meet up. Even though healthcare systems in the developed world are recording some breakthroughs due to the application of big data, it is important to research the impact of big data in developing regions of the world, such as Africa and identify its peculiar needs. The purpose of this review was to summarize the challenges faced by big data analytics and the prospects that big data opens in health care services in Africa. The systematic review examined the key research questions to address whether big data applications can improve healthcare service delivery in Africa especially during epidemics or health crises and through the population health system. The paper examined prospects and challenges that are associated with the use of big data and healthcare service in relation to population health needs through influencing factors. In this study, literatures are reviewed to present cases of big data applications in healthcare in Africa and to understand the prospect and challenges of such applications to population health.

Keywords: Big data, Healthcare, Population, Africa

1 Introduction

As the world is increasingly becoming digitalized, data are also becoming increasingly interconnected. Big data is undoubtedly becoming a major point of focus in demographic issues. Big data refers to data that is "difficult to process with current data management tools and methods" (European Union, 2014). Three important factors are considered when explaining what big data is all about, and these are volume (the amount or quantity of data), variety (the rate at which data is created), and velocity (the different types of data). There are various sources of big data. These include social networks such as Facebook, Twitter, Instagram etc., blogs and comments, personal documents, videos such as YouTube, internet searches, text messages, sensors, satellite, computer systems, and many others.

Social media are media for social interaction, and use of electronic and Internet tools for the purpose of sharing and discussing information and experiences with other human beings in more efficient ways. Social media produces a huge amount of data, with over a billion users worldwide, because of its rapidly increasing audience and subscribers (Carr and Hayes, 2015). At least 58% of the world's population have been on at least one social networking platform; 56% people use Facebook, 14% people use LinkedIn, 11% people use Twitter and 9% use Google+ (Statistic Brain, 2014).

Healthcare service delivery can benefit from the use of big data and social media. For instance, information about disease symptoms from various social network platforms can be used to identify and prevent disease outbreak and help health professionals provide timely intervention which could help save lives and

resources (Kumar, Asamoah and Shardah, 2015). On the social media, people share and discuss their views and opinions, and many share their health-related information both (Paul et al., 2016).

Big data has many benefits within the healthcare sector despite the challenges it poses, and these challenges are concerned with how information is stored, shared and managed (Kwon, Lee and Shin, 2014). As a result of its mass volumes, social media as a source of big data poses difficulties when it comes to extracting relevant information (Yin et al., 2012). Specifically, the use of social media in healthcare delivery presents some challenges, which include threat to privacy and the need to continuously monitor and manage where and when possible (Katal, Wazid and Goudar, 2013).

Based on reviews of relevant literature, this paper with examine the influence of big data and social media in healthcare delivery, the prospects and challenges that are associated with the use of big data and healthcare service in relation to population health needs, through influencing factors, and to develop a framework that can be used to improve health-related services to the patients.

2 Impact of Big Data on Healthcare Services

With Africa having the highest mortality rate in the world imbued with epidemic of diseases such as Malaria, HIV/AIDS, Polio, and the Ebola virus, big data in the continent's healthcare system is facing serious challenges (Akindele et al., 2018; Deaton and Tortora, 2016). Studies have shown that these diseases can be prevented. However, a weak healthcare system exist caused by limited and inaccurate information on disease prevalence, spread and surveillance, scarcity of competent health professionals, shortage of infrastructure to gather and monitor data, corruption and poor accountability of public office holders, and low spending on health care (Liu et al., 2016; Nsoesie et al., 2015; Anema et al., 2014).

Healthcare is among the sectors generating a massive amount of data characterized by its high velocity and variety such as laboratory data, medical prescriptions, appointments, machine generated data, insurance data, and administrative data. Big data can improve the efficiency and quality of healthcare delivery if used creatively and effectively. As noted by literatures, big data has the capacity in capitalizing prospects and avoiding threats with speed and assurance in order to create new services, models and innovative ways to enhance health (Vithiatharan, 2014; Jalali, Olabode and Bell, 2012).

Despite its challenges, several new technological improvements makes it possible for healthcare big data to be converted to useful, actionable information. For instance, with the use of an application known as GoogleFlu, experts are able to predict and locate trends in the outbreaks of flu by making use of information aggregate search queries (Williams and Hossack, 2013). With the wealth of information that healthcare data analytics provides, caregivers and administrators can make better health decisions while still delivering quality healthcare services. The big data will help to provide patients with up-to-date information to assist them to make the best decision and to comply with the medical treatment (Fatt and Ramadas, 2018).

A deep analysis of the healthcare data can help care providers manage symptoms of patients online and adjust prescriptions (Oussous et al., 2017). For instance with the development of Apple Watch and Sports bracelets, certain health data such as physical health checkups, including blood pressure, height, weight, blood-glucose levels and blood-calcium levels can be monitored in order to have a better understanding of people' health status. Even unnecessary visits to a health centre can be avoided with the use of such devices. Furthermore, with the use of big data analytics, physicians are better able to prevent prescription errors, by so doing, they are able to assess a patient's records comprehensively before they could prescribe the recommended medications. For example, through Bluetooth technology, data collected on an individual could be transmitted on a mobile phone, which can be used by care givers to detect potential healthcare issues and to interrupt treatment in case of an emergency (Nambiar, Sethi, Bhardwaj and Vargheese, 2013).

Big data analytics aid healthcare through predictive analysis. Caregivers use big data analytics to foresee high-risk patients that are vulnerable to chronic diseases in order to provide them the care they need before the health issue becomes an unmanageable problem (Kumar, Eswari, Sampath and Lavanya, 2015). For instance, in cases of asthma attacks, Data related to the place and time of inhaler's use is collected in real

time via global positioning system (GPS). The recorded data is transferred to a web site accessible by the patient and doctor via a smartphone or computer.

Big data can also benefit healthcare through data management, which includes organizing, cleaning, retrieval, data mining, and data governance (Senthilkumar et al., 2018). This helps in risk assessment of patients. Big data analytics assist healthcare practitioners to allocate resources. For instance, the analysis of data reduces the use of expensive healthcare equipment and devices. In addition, pharmaceutical organizations take profit from analytic advantages in the elaboration of marketing strategies. Furthermore, the analysis of patient demographic data, such as age and gender, and clinical data, such as disease and drugs history, the insurer is able to elaborate an appropriate health plan for each patient (Palanisamy and Thirunavukarasu, 2017). Data such as clinical data, doctor's comments and prescription, laboratory test results, pharmaceutical records, health insurance reports, administrative reports, patient historical data, posts on social media platforms such as, Facebook and Twitter, blogs, and other information that are not directly connected to patients, such as, news in health magazines and relevant publications in medical journals (Raghupathi and Raghupathi, 2013). Big Data Analytics plays a key role in the enhancement of medical services and increases patient satisfaction. Consequently, it has the potential to improve care, save lives and lower costs.

One big step that healthcare administrators in Africa have taken in recent times that have paved way for the use of big data is the use of electronic surveillance to detect outbreaks of infectious disease. In combatting infectious diseases, early detection and surveillance is critical. A digital surveillance that has been used successfully used globally and in Africa is HealthMap (Akindele et al., 2018). Health organizations such as WHO rely on systems such as a HealthMap to detect epidemics. For instance, the dreaded Ebola outbreak in West Africa first came to global knowledge on 14th March, (2014), after HealthMap retrieved it from a French news website that reported a deadly fever in Guinea. Based on that report, Sierra Leone which shares border with Guinea officially declared on 23rd of March, that Ebola might have spread into Sierra Leone. Then on the 8th of August (2014), WHO declared Ebola as an outbreak of public health emergency of international concern. In addition, through HealthMap surveillance, new cases of Polio was detected in a war-torn north-western Nigeria. The strength of HealthMap as a disease location detection tool is based in its capability to pool huge, diverse and unstructured internet data, and extract useful information for users of public health (WHO, 2016; CDC, 2016)

3 Big Data and the Social Media

Social networking websites such as Twitter, Facebook, LinkedIn, YouTube, and Wikipedia have not only connected large user populations but have also captured dozens of information associated with their daily interactions. These social media platforms enable people to share information instantaneously. Big data derived from social media platforms does not require expensive infrastructure as it allows for ease in storing and analyzing data. Also, such big data technologies can handle varying formats of data in large quantities (Kumar et al., 2015).

Social media, as a source of big data, plays an important role in healthcare delivery. Social media platforms assist in timely detection and intervention of disease outbreak, which could go a long way in saving lives and resources. Internet users used social media, such as online news group, Websites, and blogs, to read other patients' commentaries and experiences about health or medical issues (Ji, Chun, Cappelari and Geller, 2016). On Twitter, for example, there are healthcare communities such as *MedHelp*, *PatientsLikeMe* and many others where people turn to for their health needs (Househ, Borycki and Kushniruk, 2014; Ji et al., 2010). It is interesting to note that healthcare information can be derived from research communities. Patients and caregivers can use such resources to solve their health-related problems. For instance, *PubMed* contains more than 22 million scientific publications from *MEDLINE*, life science journals, and online books (Harth and Gil, 2014).

Big data analytics is emerging in Africa and can be a big weapon to improve healthcare and to end many diseases plaguing the continent. Even though there are scarcity of sophisticated equipment in many parts

of Africa to provide the best healthcare, increased use of social networks (Facebook, Twitter, WhatsApp, WeChat etc.), mobile devices and the internet in Africa is making possible the generation of data that can be used for disease surveillance. With the abundance of mobile phone usage in Africa, it becomes easier to collect data on people's behavior as it relates to their health conditions. For instance, within the field of digital epidemiology, big data from social media network and mobile phones can be used to monitor, prevent, detect, and treat diseases, just as it is being done in the developed regions of the world (Salathe et al., 2012). According to a study by Young et al (2014), when over 500 million tweets in the United States were collected online and sifted using HIV related keywords, the result of the analyses showed that there was a strong positive correlation between HIV-related tweets and reported HIV cases across the United States. This shows that big data from social media and mobile phones provide a unique opportunity to monitor risk of disease transmission in Africa.

During the Ebola crisis in Africa, one tool that was useful were mobile phones (Wall, 2014). Mobile phones were utilized by data scientists to tap into the rich source of data provided by phone companies, to visualize population movements of Ebola Patients and forecast of how the virus can spread. As Wall (2014) reported, a telecom provider in one of the countries affected in West Africa, supplied anonymised voice calls and text messages from about 150,000 mobile phones to Flowminder, a Swedish non-govenmental organization. By so doing, healthcare authorities were able to plan on best places to set up treatment centres, and even devise means to limit travel in order to control the disease.

4 Prospects of Big Data in Healthcare Delivery

With big data, can gain dynamic and real time data in healthcare (Vithiatharan, 2014). With big data, health practitioners are better equipped with the understanding of new diseases in their natural and geographical setting (Hay, George, Moyers and Brownstein, 2013). As Harper (2013) noted, big data has the ability to replace and support human decisions in order to manage population health and make better decisions. This enables the building of an evidence based best practice and learning in the health care system.

Recently, healthcare organizations are employing business intelligence solutions to make use of data for accurate decision-making to help improve services provided to patients, reduce administrative and service costs, and safeguard the prospect of healthcare industry (Ashrafi, Kelleher, & Ku, 2014). Consequently, healthcare delivery is now a business venture for healthcare providers and professionals, thereby propelling BI to gain tremendous attention in this sector (Bonney, 2016). Business Intelligence as an architecture provides a framework that shows processes, which connect both internal and external actors within the healthcare environment (Mettler & Vimarlund, 2009). Thus, decision makers in healthcare need to be mindful of those processes in order to have an understanding of the usefulness of business intelligence in healthcare. Adoption of business intelligence in healthcare in African Countries are emerging and it is expected to grow due to the rise in usage of mobile technologies, social media platforms by the populace, rise in the adoption of cloud computing and rise in the use of electronic medical data within the healthcare community (Akindele , Dharini and Oluyemi, 2018).

Although big data is still emerging in Africa, it can be a big weapon to transform the healthcare system and to end many diseases plaguing the continent. It is for this reason that few research efforts on the usefulness of big data in African healthcare made use of data from mobile phones, and social media (Akindele et al., 2018). In addition, data from social media pages can provide accurate information on human behavior (Kum, Krishnamurthy, Machanavajjahala and Ahalt, 2014). Such data can pave the way to have a better informed and effective policy decisions and management of social programs. Thus, public health professionals are able to look at the long terms effects of how society behaves and evolves. For example, with the help of GoogleFlu, health practitioners can have firsthand information on flu outbreak (Google.org flu trends, 2011).

5 Challenges Facing Big Data in Healthcare Delivery

Big data is not easily accessible. This is because there are non-standard computation facilities for storage, management and analysis of data (Pope, Halford, Tinati and Weal, 2014; Clansy et al., 2014; Ragupathi & Ragupathi, 2014). Specifically, Pope et al., (2014) explained that the utilization of big data is dependent on where and how the data was collected in order to analyse and categorise them. Therefore, data that is without meaning becomes invalid and unusable, thus it is one thing to have data and it is another thing for it to meet its desired purpose (Harper, 2013). In Africa, we have lots of data but lack little knowledge and information on how to make adequate use of such data (Vithiatharan, 2014). With the heterogeneous nature of African societies, data collected may be unreliable and volatile, which may affect the effective use of such data (Ola and Sedig, 2014).

Big data is susceptible to hacking, cyber theft and phishing, where the stolen data can be sold for a huge sum (Wakaskar, 2017; Liu et al., 2015). Research about healthcare information systems (HISs) pays little attention to privacy protection (Kum & Ahalt, 2013; Kum et al., 2014). There is therefore a need to address policies linked to privacy and security in the utilization of big data. The right technology, talent and incentives is needed by organizations to ensure full maximization of big data. As Williams and Hossack (2013) pointed out, poor implementation of legislations and policies on big data are often rushed which lead to security and privacy breach. This jeopardizes a patient's trust, autonomy and peace of mind which may result in the patient's unwillingness to share information.

Accessibility is another key challenge. Having access to big data for scientific studies is challenging due to privacy issues (Mohammad et al., 2017). Even individuals do not even have access to their own data (David et al., 2014). The fear of litigation and breach of privacy due to federal and local laws that protect such data discourages providers from sharing patient health data (Alistair et al., 2016). Thus, privacy becomes a factor that makes it sometimes difficult to access health data. In addition, the ownership of big data becomes an issue. A key question any healthcare delivery system faces is: who owns the data? Is it the healthcare providers, patients, insurance companies or software vendors? The issue of proprietary rights for big data makes it difficult for individual patients to share data for scientific research and discourage patients to obtain their own health records that may help better manage their care and improve patient engagement (Mohammad et al., 2017).

Lack of incentives for big data is another issue for big data. An individual health system does not usually have the incentive to make these data organized and available for research, unless they are big academic institutions. Unless big data are organized and captured using standard nomenclature and with meaningful and useful detailed information with significant detail, then it would be easy to share big data.

Weak health systems and limited governance structures weaken big data in Africa. Many of the countries in Africa struggle to collect even simple data on mortality and natality rates (Wyber et al., 2015). Even if such data are collected, their authenticity is often unreliable. As the United Nations reported "it is important to recognize that big data and real-time analytics are no modern panacea for age-old development challenges" (United Nations, 2012). This implies that data collection may only be possible at the expense of tangible health services.

6 Conclusions

The role of big data in healthcare delivery in Africa cannot be disputed. Thus, data system need to be well developed to support health in the African continent. Big data is required in healthcare system to facilitate seamless communication amongst healthcare providers and patients, it increases patients' participation in the care process, it results in evidenced based care and it also facilitates the early detection of security threats and fraud. Big data analytics has the potential for positive impact and global implications; however, it must overcome some legitimate obstacles in Africa before its effectiveness can be explored. Using big data to help manage and evaluate a population health program has led to several improvements in health care services deliveries. Program management, reporting, and evaluation processes generated additional data

which, when analyzed, continues to refine program implementation and quality and this also have tones of effect on infant and maternal mortality.

7 Competing Interest

The authors declared that no conflict of interest exist in the publication of this work.

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References

Akindele, A., Dharini, P., and Oluyemi, A. (2018). Prospects of Big Data Analytics in Africa Healthcare System. *Global Journal of Health Science; Vol. 10, No. 6.*

Alistair, E.W., Tom, J.P., Lu, S., Li-wei, H.L., Mengling, F., Mohammad, G., Benjamin, M., Peter, S., Leo, A.C., and Roger, G.M. (2016). Mimic-iii, a freely accessible critical care database. *Scientific data, 3.*

Anema, A., Sheryl, K., Kumanan, W., Robert, S. H., Kamran, K. and, John, S. B. (2014). Digital surveillance for enhanced detection and response to outbreak. *The Lancet, Infectious diseases 14(11)*, 1035.

Ashrafi, N., Lori, K., & Jean-Pierre, K. (2014). The impact of business intelligence on healthcare delivery in the USA. *Interdisciplinary Journal of Information, Knowledge, and Management, 9, 117-130.*

Bonney, W. (2016). Applicability of Business Intelligence in Electronic Health Record. *Social and Behavioral Sciences, 73, 257-262.*

Carr, C.T., and Hayes, R.A. (2015). Social Media: Defining, Developing, and Divining, Atlantic *Journal of Communication, 23:1, 46-65*. DOI: 10.1080/15456870.2015.972282.

CDC. (2016). Ebola Outbreak in West Africa. June 22. Retrieved September 16, 2016, from. http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/

Clansy, T., Bowles, K., Gelias, L., Androwich, I., Delaney, C., Matney, S., Sensmeier, J., Warren, J., Welton, J. & Westra, B. (2014). A call to action: Engage in big data science. *American Academy of Nursing on Policy, 62, 64-65.*

David, W.B., Suchi, S., Lucila, O., Anand, S., and Gabriel, E. (2014). Big data in health care: using analytics to identify and manage high-risk and high-cost patients. *Health Affairs, 33(7):1123–1131*.

Deaton, A.S., and Tortora, R. (2016). People in Sub-Saharan Africa Rate Their Health and Health Care among the Lowest in the World. *Health Affairs 34 (3): 519-527.*

European Commission. (2014). Communication from the Commission: Towards a Thriving Data-Driven Economy. COM/ 2014/442.

Fatt, Q.K., Ramadas, A. (2018). The Usefulness and Challenges of Big Data in Healthcare. *J Healthc Commun Vol.3 No.2:21.*

Google.org flu trends. (2011). Retrieved from the Google.org site: http://www.google.org/flutrends/intl/en_us/

Harper, E. (2013). The economic value of health care data. *Nurse Administration Quarterly, 37(2), 105-108.*

Harth, A., and Gil, Y. (2014). Geospatial data integration with linked data and provenance tracking, in: W3C/OGC Linking Geospatial Data Workshop, pp. 1–5.

Hay, S.I., George, D.B., Moyers, C.L., and Brownstein, J.S. (2013). Big data opportunities for global infectious disease surveillance. *PLOS Medicine, 10(4*), e1001413-e100141x.

Househ M., Borycki, E., and Kushniruk A. (2014). Empowering patients through social media: the benefits and challenges. *Health Informatics Journal; 20: 50–58*.

Jalali, A., Olabode, O.A., and Bell, C.M. (2012). Leveraging cloud computing to address public health disparities: An analysis of the SPHPS. *Online Journal of Public Health Informatics, 4(3), e13-e20.*

Ji, Y.G., Hwan, H., Yi, J.S., et al. (2010). The influence of cultural differences on the use of social network services and the formation of social capital. *International Journal of Human-Computer Interaction 26(11–12): 1100–1121.*

Katal, A., Wazid, M., and Goudar, R.H. (2013). Big data: Issues, challenges, tools and Good practices. Sixth International Conference on Contemporary Computing (IC3).

Kum, H., and Ahalt, S. (2013). Privacy-by-Design: Understanding Data Access Models for Secondary Data. AMIA Jt Summits Transl Sci Proc.: 126–130.

Kum, H., Krishnamurthy, A., Machanavajjahala, A., Ahalt, S. (2014). Social genome: Putting Big Data to Work for Population Informatics. *Computer, 18, 56-63.*

Kumar, A., Asamoah, D, and Sharda, R. (2015). Can Social Media Support Public Health? Demonstrating Disease Surveillance using Big Data Analytics. Twenty-first Americas Conference on Information Systems, Puerto Rico, 2015.

Kumar, N.M., Eswari, T., Sampath, P., and Lavanya, S. (2015). Predictive Methodology for Diabetic Data Analysis in Big Data. *Procedia Comput. Sci. 50 203–208*.

Kwon, O., Lee, N. and Shin, B. (2014). Data Quality Management, Data Usage experience and Acquisition Intention of Big Data Analytics. *International Journal of Information Management, Volume 34, Issue 3.*

Liu, J., et al. (2015). Rethinking big data: A Review on the Data Quality and Usage Issues. *ISPRS J. Photogram. Remote Sensing*.

Liu, K., Li, L., Jiang, T., Chen, B., Ji, Z., Wang, Z., and Gu, H. (2016). Chinese Public Attention to the Outbreak of Ebola in West Africa: Evidence from the Online Big Data Platform. *International journal of environmental research and public health, 13(8), 780*.

Mettler, T., & Vimarlund, V. (2009). Understanding business intelligence in the context of healthcare. *Health informatics journal, 15(3), 254-264*.

Mohammad, A., Poching, D., Jennifer, H., and Brian, D.B. (2017). Big data in healthcare– the promises, challenges and opportunities from a research perspective: A case study with a model database. Computing in Cardiology, 2017.

Nambiar, R., Bhardwaj, R., Sethi, A., Vargheese, R. (2013). A look at challenges and opportunities of Big Data analytics in healthcare. *Proc. - 2013 IEEE Int. Conf. Big Data*, 17– 22.

Nsoesie, E. O., Kluberg, S. A., Mekaru, S. R., Majumder, M. S., Khan, K., Hay, S. I., & Brownstein, J. S. (2015). New digital technologies for the surveillance of infectious diseases at mass gathering events. *Clinical Microbiology and Infection, 21(2), 134-140.*

Ola, O. & Sedig, K. (2014). The challenge of big data in public health: An opportunity for visual analytics. *Online Journal of Public Health Informatics, 5(3), e223-e245*.

Oussous, A., Benjelloun, F.Z., AitLahcen, A., and Belfkih, S. (2017). Big Data Technologies: A Survey. *Journal of King Saud University: Computer and Information Sciences, pp. 01-18.*

Palanisamy, V., and Thirunavukarasu, R. (2017). Implications of big data analytics in developing healthcare frameworks – A review. *Journal of King Saud University – Computer and Information Sciences.*

Paul, M.J., Sarker, A., Brownstein, J.S., Nikfarjam, A., Scotch, M., Smith, K.L., and Gonzalez, G. (2016). Social Media Mining for Public Health Monitoring and Surveillance. Pacific Symposium on Biocomputing.

Pope, C., Halford, S., Tinati, R. & Weal, M. (2014). What's the big fuss about big data? *Journal of Health Services Research and Policy, 19(2), 67-68.*

Raghupathi, W., & Raghupathi, V. (2013). An overview of health analytics. *J Health Med Informat, 4(3), 1-11*

Salathé, M. and Khandelwal, S. (2011). Assessing Vaccination Sentiments with Online Social Media: Implications for Infectious Disease Dynamics and Control. *PLOS Computational Biology*. 7, e1002199.

Senthilkumar, S.A., Bharatendara, K.R., Amruta, A.M., Angappa, G., and Chandrakumarmangalam, S. (2018). Big Data in Healthcare Management: A Review of Literature. *American Journal of Theoretical and Applied Business. Vol. 4, No. 2, 2018, pp. 57-69.*

Statistic Brain. (2014). "Social Networking Statistics," (available at http://www.statisticbrain.com/socialnetworking-statistics/).

UN. (2012). A social media boom begins in Africa.

Vithiatharan, R. (2014). The potentials and challenges of big data in public health. Australian Ehealth Informatics and Security Conference.

Wakaskar, R.R. (2017). Challenges Pertaining to Adverse Effects of Drugs. *Int J Drug Dev & Res 9: 01-02*.

Wall, M. (2014). Ebola: Can big data analytics help contain its spread. BBC News. Retrieved from http://www.bbc.com/news/business-29617831

WHO. (2016). Ebola data and statistics. http://apps.who.int/gho/data/view.ebola-sitrep.ebola-summary-latest?lang=en. Accessed September 19, 2016.

Williams, P.A.H. & Hossack, E. (2013). It will never happen to us: The likelihood and impact of privacy breaches on health data in Australia. In H. Grain (ed.) Studies in Health Technology and Informatics, pp. 155-168. IOS Press: Amsterdam.

Wyber, R., Vaillancourt, S., Perry, W., Mannava, P., Folaranmi, T., and Celid, L.A. (2015). Big Data in Global Health: Improving Health in Low- and Middle-Income Countries. *Bull World Health Organ; 93(3): 203–208*

Xiang, J., Chun, S.A., Cappellari, P., Geller, J. (2016). Linking and using social media data for enhancing public health analytics. *Journal of Information Science 1–25*.

Yin, J., Karimi, S., Lampert, A., Cameron, M., Robinson, B., and Power, R. (2012). Using Social Media to Enhance Emergency Situation Awareness. Proceedings of the Twenty-Fourth International Joint Conference on Artificial Intelligence (IJCAI 2015).

Young, S. D., Rivers, C., & Lewis, B. (2014). Methods of using real-time social media technologies for detection and remote monitoring of HIV outcomes. *Preventive medicine, 63, 112-115*.